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DIVERSITY AND DISTRIBUTION OF ASCIDIANS (TUNICATA) IN THE PELICAN CAYS, BELIZE

BY

IVAN GOODBODY

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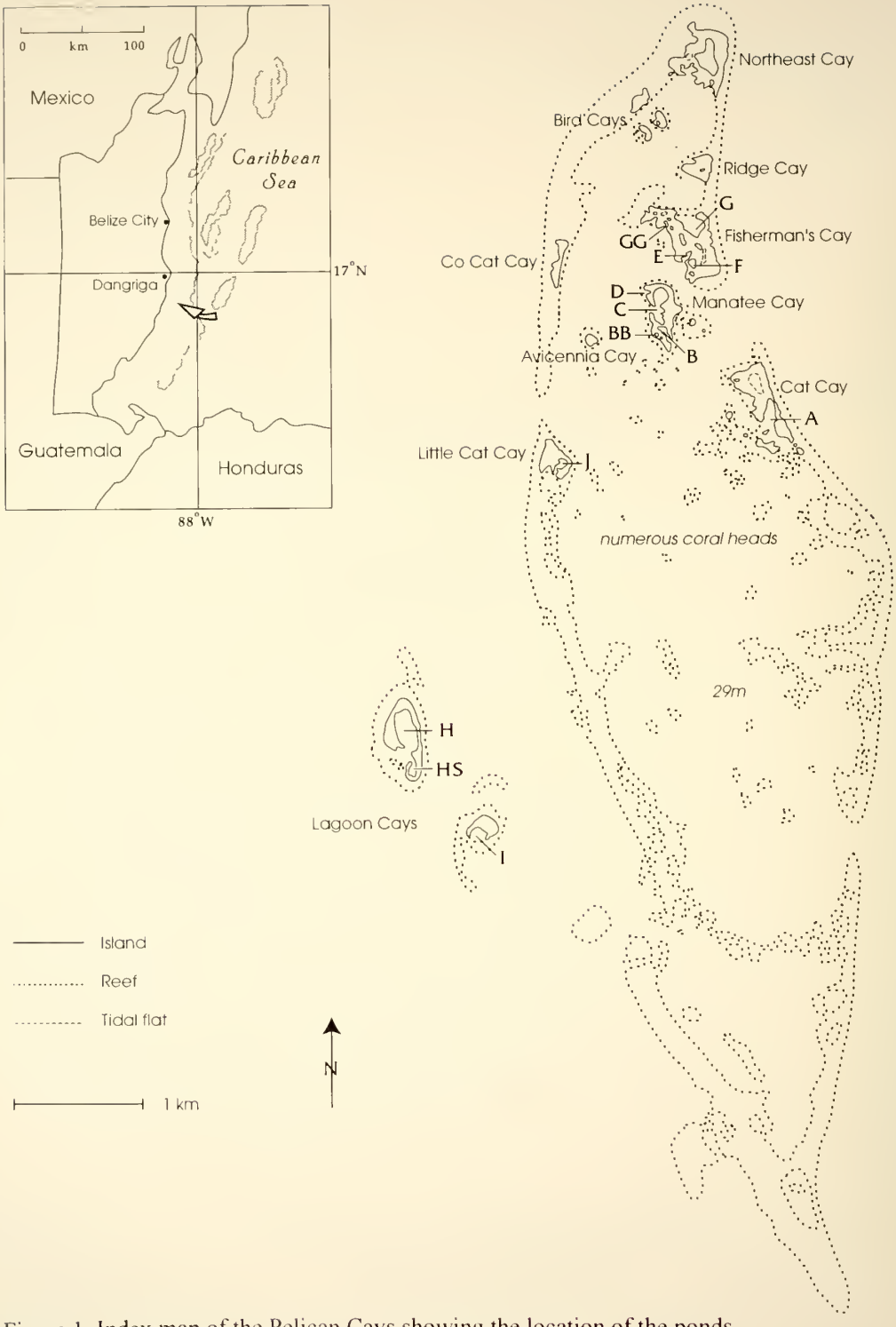

Figure 1. Index map of the Pelican Cays showing the location of the ponds.

DIVERSITY AND DISTRIBUTION OF ASCIDIANS (TUNICATA) IN THE PELICAN CAYS, BELIZE

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ABSTRACT

The Pelican Cays at the southern end of the Belize Barrier Reef, Central America, have a rich ascidian fauna. Seventy species in thirty genera, primarily from mangrove ponds and coral ridges, are recorded here. This number of species represents 60% of all known shallow-water ascidians in the Caribbean. The inventory includes two species normally associated with the Indo-Pacific region, *Diplosoma virens* and *Botrylloides perspicuum.* The principal habitat of each species in the Pelican Cays and the general ecology of the ascidian fauna are also discussed.

INTRODUCTION

The Ascidiacea (sea squirts) are soft-bodied sessile marine invertebrate animals that are common throughout the tropical Caribbean. Many species occur as solitary individuals (zooids) but others, as a result of complex asexual replicatory mechanisms, live in colonies of varying form. Some (e.g., *Ecteinascidia turbinata*; Plate 3e) form bushy clusters, others (e.g., *Polyclinum constellatum*) form cushions, while still others (e.g., species of *Didemnum, Botryllus,* and *Symplegma*) grow as flat encrusting sheets.

My observations at various locations (Jamaica, Belize, Netherlands Antilles) suggest that the distribution and abundance of ascidians in the Caribbean is determined by a number of environmental factors:

(1) Ascidians require a hard substratum on which the larva can settle and metamorphose and hence on which the adult zooid or colony can grow. As a result, their occurrence in the Caribbean tends to be limited to the undersurface of stones and boat hulls, and to pilings, piers, and the hanging roots of the red mangrove (*Rhizophora mangle*).

(2) Ascidians appear to prefer shaded rather than brightly illuminated places. In *Rhizophora*-root communities, they tend to be abundant where the canopy overhang is dense, and on reef flats they occur mainly on the undersurface of stones except in species such as *Diplosoma virens,* which contain algal symbionts and grow in brightly illuminated situations.

(3) In general, ascidians are absent from localities with strong wave action or surge. Thus they are uncommon on exposed reef faces and are often less abundant on the windward side of mangrove lagoons exposed to the trade winds than on the leeward side where conditions are sheltered.

(4) Although dependent on suspended organic particulate matter and phytoplankton for food, ascidians appear intolerant of high concentrations of such material because it may clog their filtration system. Only a few species (e.g., *Ascidia interrupta, A. sydneiensis, Polycarpa*

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[1]Department of Life Sciences, University of the West Indies, P.O. Box 12, Kingston 7, Jamaica.

spongiabilis, Herdmania momus, Pyura munita, Molgula occidentalis) are regularly found living in soft substrata. When removed from the substratum, such animals are usually attached to a small shell or other hard object that the larva has apparently selected for settlement.

Although the preceding factors appear to play an important role in the distribution and abundance of the ascidian fauna of the Pelican Cays, it must be remembered that these are by and large untested observations, several of which could be subjected to more rigorous scientific examination. This is particularly true in the case of the effect of light on adult ascidians. Some species have special pigmentation over the area of the neural gland and ganglion; for instance, *Perophora regina* has a conspicuous area of white pigment over the neural region; *Corella minuta,* which tends to live under stones on reef flats where it is protected from bright light, has a glassy, transparent test flecked with yellow or white pigment, but if the stone is turned over and the animal left exposed to light, pigment concentrates in a patch over the neural region (personal observations). On the other hand, *Eudistoma olivaceum* exhibits a small black pigment spot at the anterior end of the endostyle, suggesting that there may be some benefit in protecting this region from bright light. (For further discussion of environmental conditions affecting ascidian distribution see Kott, 1974.)

The physiography of the Pelican Cays is described elsewhere in this volume (Macintyre et al.), and the nomenclature used therein for localities is followed throughout this discussion.

METHODS

Between 1991 and 1996 I made 17 visits to the Pelican Cays, during which I documented the occurrence of ascidians in all major habitats, including the mangrove ponds, all the ridges connecting the mangrove islands, and most of the reef area to the south of the islands, in addition to the two ponds at the Lagoon Cays (H & I).

All observations were made by free swimming with face mask and snorkel, working slowly around the margins of the ponds, examining hanging roots and the margin of the peat bank and any other structures on which ascidians might grow. The same technique was used on the ridges and reef flats, usually with the assistance of a companion so that stones and boulders could be raised and their undersurfaces examined. All such stones were usually replaced in their original position after examination. In a few instances, scuba divers assisted by raising stones from the deeper parts of the reef or ridge or collecting specimens from the bottom of the ponds.

With experience, most species of ascidian can be identified in situ in the field; in cases of doubt, specimens were collected, returned to the laboratory, relaxed with menthol for 4 to 5 hours, fixed in formaldehyde, and later transferred to 70% ethyl alcohol for storage.

THE ASCIDIAN FAUNA

Thus far, 117 species of shallow water ascidians in 39 genera have been recorded from the Caribbean (cf. Monniot and Monniot, 1984; Van Name, 1945; Millar, 1962; Millar & Goodbody, 1974; Goodbody, 1984a, 1984b, 1993, 1994). Specimens recorded for the ponds and reefs of the Pelican Cays total 70 species in 30 genera, thus making this locality an area of high diversity. By comparison, Monniot and Monniot (1994) have recorded 93 species in 36 genera from the island of Guadeloupe in the eastern Caribbean. Further exploration will almost certainly increase the inventory of species at both locations.

The occurrence and distribution of all species of ascidian recorded from the Pelican Cays and their associated reefs and ridges are summarized in Table 1. It is noteworthy that representatives of Corellidae have not been recorded from the Pelicans although two species of that family (i.e., *Corella minuta, Rhodosoma turcidum)* were expected to occur there. *Corella minuta* Traustedt, 1882, is a solitary globular species with a glassy translucent test often speckled with yellow pigment. It is normally a reef species that occurs under stones, often in clusters of four or more zooids. It has been recorded elsewhere on the barrier reef but not as yet at the Pelican Cays. *Rhodosoma turcicum* (Savigny, 1816) is another small solitary species found elsewhere in the Caribbean in mangrove-root communities (cf. Van Name, 1945; Millar, 1962; Goodbody, 1993). I have no records of it in the Pelican Cays or elsewhere on the barrier reef. Background information on the ascidian fauna of the Pelican Cays and on the need for management and conservation of the area has been published elsewhere (Goodbody, 1995).

A full account of ascidian taxonomy is given in Kott (1985, 1992) and in the present paper the taxonomic sequence of the families in the suborders follows her arrangement. In keeping with Kott's classification, *Rhopalaea abdominalis* is retained in the Diazonidae in the suborder Aplousobranchia, which differs from C. Monniot (1983a) who places this species in the Cionidae in the suborder Phlebobranchia.

Suborder: Aplousobranchia

Family: Polyclinidae

Aplidium antillense (Gravier, 1955)

There is a single unconfirmed record of this species from the ridge at the entrance to Pond A, but I have no other records of its occurrence. Elsewhere in the Caribbean it is recorded from Martinique and Guadeloupe (F. Monniot, 1983b) and from Port Royal Harbour, Jamaica (Goodbody, unpublished data).

Aplidium bermudae (Van Name, 1902)

A. bermudae is common on the peat bank surrounding some of the ponds and is especially abundant in the northwest corner of Pond C, where it grows on the top of a sloping peat bank; colonies are usually small cushions with an opalescent blue tinge to the test. The species is also frequently found on the undersurface of stones on reef ridges.

Aplidium constellatum (Verrill, 1871)

A single, very flattened colony was collected from the peat bank in Pond C in April 1994 and is the only record I have from the Belize Barrier Reef. Van Name (1945) considered the species to be very rare in the West Indies; F. Monniot (1983b) records it from Guadeloupe, but it was not recorded by Millar (1962) in the Caribbean collections examined by him, and no specimens were found in the extensive Caribbean collections made by P. Wagenaar Hummelinck between 1930 and 1973 (cf. Goodbody, 1984a). I have no records of the species in Jamaica.

Aplidium exile Van Name, 1902

This species usually forms much larger cushion-like colonies than *A. bermudae* and, unlike that species, is usually pink or bright red. It is not a common species and though

Table 1. Occurrence of ascidian species at Pelican Cays. The ponds are identified by their respective letter or letters. R represents the reefs and ridges in the vicinity of the ponds. Taxonomic sequence follows Van Name (1945). (X = present, ? = uncertain occurrence).

Species	Locations													
	R	A	B	BB	C	D	E	F	G	GG	H	HS	I	J
Family Polyclinidae														
Aplidium antillense		?												
Aplidium bermudae	X	X			X									
Aplidium constellatum					X									
Aplidium exile	X	X			X		X							
Polyclinum constellatum	X		X	X								X	X	
Aplidiopsis stellatus	X													
Family Euherdmaniidae														
Euherdmania fasciculata	X													
Trididemnum cyanophorum	X													
Trididemnum hians	X	X			X				X		X			
Trididemnum orbiculatum	X	X			X						X			
Trididemnum solidum	X													
Didemnum amethysteum		X												
Didemnum cineraceum		X												
Didemnum conchyliatum[a]	X	X	X				X				X			X
Didemnum duplicatum	X	X			X						X	X		
Didemnum inauratum		X												
Didemnum perlucidum	X	X												
Didemnum psammathodes			X	X						X				
Lissoclinum abdominale	X	X			X				X					X
Lissoclinum fragile		X	X	X	X				X			X	X	X
Lissoclinum verrilli	X	X			X		X				X	X		
Diplosoma glandulosum	X	X	X		X		X		X		X			X
Diplosoma listerianum[a]	X	X	X		X				X	X	X			X
Diplosoma virens	X													
Family Polycitoridae														
Distaplia bermudensis	X	X			X		X							
Distaplia corolla	X	X	X	X	X			X	X		X	X		X
Cystodytes dellechiajei	X	X			X		X				X			X
Eudistoma capsulatum	X	X			X		X							
Eudistoma clarum	X	X			X						X			X
Eudistoma obscuratum	X	X			X		X		X		X	X		X
Eudistoma olivaceum	X	X	X	X	X		X	X			X	X		X
Clavelina oblonga	X													
Clavelina picta	X	X			X		X	X	X					

Table 1.--continued

Species	Locations													
	R	A	B	BB	C	D	E	F	G	GG	H	HS	I	J
Clavelina puertosecensis[a]	X	X			X		X	X	X	X				
Family Pycnoclavellidae														
Pycnoclavella belizeana									X					
Family Diazonidae														
Rhopalaea abdominalis	X	X												
Family Perophoridae														
Perophora carpenteria	X	X		X	X		X	X	X		X			X
Perophora multiclathrata	X													
Perophora regina			X											
Perophora viridis	X	X	?	X	X		X	?					?	
Ecteinascidia conklini	X													
Ecteinascidia minuta	X	X	X		X		X	X			X	X		X
Ecteinascidia styeloides	X		X									X	X	
Ecteinascidia turbinata[a]		X		X	X					X				
Family Ascidiidae														
Ascidia corelloides	X													
Ascidia curvata	X													
Ascidia interrupta	X	X	X	X	X	X	X	X	X		X	X		X
Ascidia nigra	X	X	X	X	X	X	X	X	X	X	X			X
Ascidia sydneiensis	X	X			X		X				X			
Family Styelidae														
Botrylloides nigrum	X	X	X						X				X	X
Botrylloides perspicuum	X	X	X				X		X					
Botryllus planus	X		X				X							
Botryllus tuberatus	X	X			X			X						
Symplegma brackenhielmi	X	X	X		X		X		X		X	X	X	X
Symplegma rubra							X							
Tibitin halimedae	X													
Polyandrocarpa tincta	X	X			X		X	X	X					
Polycarpa aurita	X	X			X		X		X					X
Polycarpa cartilaginea	X													
Polycarpa spongiabilis	X	X	X		X	X	X	X	X		X			X
Polycarpa tumida	X													
Styela canopus	X	X	X		X		X	X	X		X			X
Family Pyuridae														
Herdmania momus	X	X			X				X		X			X
Pyura lignosa	X	X	X	X	X		X	X	X		X			X
Pyura munita	X	X			X		X		X		X			X
Pyura vittata	X	X	X		X		X	X	X		X	X		X

Table 1.--continued

Species	Locations													
	R	A	B	BB	C	D	E	F	G	GG	H	HS	I	J
Microcosmus exasperatus	X	X	X	X	X		X	X	X	X	X	X		X
Halocynthia microspinosa	X	X					X		X		X			
Bathypera goreaui	X													
Family Molgulidae														
Molgula occidentalis		X			X		X		X		X			X

[a] See Plate 3

essentially a reef-dwelling species living under stones, it has been recorded from the peat bank in several of the ponds at Pelican Cays, notably Ponds A and E.

Polyclinum constellatum Savigny, 1816

Elsewhere this species is sometimes abundant in mildly eutrophic lagoons, as in Lagoen Boekoeti, Aruba; Piscadeera Bay, Curaçao; and Port Royal, Jamaica (Goodbody, 1984a, 1984b, 1993). In the Pelican Cays it was not common anywhere except in Pond B, where it accounted for 7% of all ascidian species recorded on mangrove roots over a 50-m stretch of pond bank in August 1995. It also occurs occasionally in other ponds, notably Ponds BB, I, and in the side arm of Pond H; on the reef ridges it seems to occur only in places where there are high levels of suspended particulates.

Aplidiopsis stellatus Monniot, 1984

This species forms small greenish-yellow colonies of stalked capitate heads usually growing on the undersurface of stones on the reef. It is not common, and I have only recorded it from the ridges.

Family:Euherdmaniidae

Euherdmania fasciculata Monniot, 1983

The species forms small translucent colonies on the undersurface of stones on reefs and ridges. When first observed, the colony bears a superficial resemblance to a small bubble on the stone. The species is relatively common on the southern ridges. Each colony consists of three or four capitate lobes joined to one another, each of which contains two or three zooids; the whole colony is 3 to 4 cm high, and individual zooids are about 3 mm long.

Family: Didemnidae

The taxonomy of this large family is still poorly understood. Most species form sheet-like colonies, usually containing an abundance of small calcareous star-shaped spicules in the test substance. With few exceptions, individual species are very difficult to recognize in the field. The best contemporary guide to the identification of Caribbean species has been compiled by Françoise Monniot (1983a, 1984) describing the didemnids of Guadeloupe in the eastern

Caribbean.

Tridemnum cyanophorum Lafargue et Duclaux, 1979

Colonies form clusters of rounded lobes, usually pinkish or purple in color owing to the presence of symbionts. It occurs on the reefs and ridges but is not common. A small colony was collected from the reef crest at Pond A in April 1993. For comments on the relationship between this species and *T. solidum,* see below.

Tridemnum hians Monniot, 1983

The species is common in the ponds, often growing as flat sheets on the exposed peat bank. Colonies are usually translucent grey and in the field are easily confused with *Cystodytes dellechiajei.* In *T. hians* the spicules tend to aggregate toward the base of the colony around the abdominal region of the zooids; confusion can occur because *C. dellechiajei* also has spicules surrounding the abdomen of each zooid, albeit spicules of a quite different nature (vide infra) and in each species the test is sufficiently transparent for the spicules to be visible through it.

Tridemnum orbiclatum (Van Name, 1902)

The species forms white colonies but lacks any clear distinguishing features that would make it easy to recognize in the field. It has been recorded only from Ponds A, C, and H, where it was found growing on roots or directly on the exposed peat bank, and sometimes on the test of large solitary ascidians.

Tridemnum solidum (Van Name, 1902)

Although F. Monniot (1983a) considers *T. solidum* and *T. cyanophorum* to be perhaps synonyms for one another, I have kept the species separate here, as is customary, on the grounds that typical *T. solidum* lacks the conspicuous pink or purple coloration of *T. cyanophorum* and forms larger mound-like whitish-grey colonies on reef structures. Although I have seen typical *T. cyanophorum* on Pelican Cays reefs, I have seen typical *T. solidum* infrequently.

Didemnum (Polysyncraton) amethysteum (Van Name, 1902)

A small elongate colony of this colorful species was collected from the rim of pond A in the southeast corner of the pond on April 12, 1992. This is the only record I have of this species in the Pelican Cays but, its occurrence on the pond rim suggests that it may occur more commonly in cryptic situations on reefs and ridges, and its presence may have been overlooked because of the difficulty of exploring these cryptic situations without damaging the reef structure.

Didemnum cineraceum (Sluiter, 1898)

Like many other didemnids, the species is difficult to identify in the field. Colonies form flat, greyish encrusting sheets, with the zooids usually showing white through the test. The species has been found only in Pond A.

Didemnum conchyliatum (Sluiter, 1898) (Plate 3a)

D. conchyliatum was the most common of all didemnids found in the Pelican Cays and elsewhere on the Belize Barrier Reef. In the ponds and lagoons, it grows on *Rhizophora* roots and directly on the exposed peat bank and is often a bright orange, sometimes a dull grey; the

abundance of spicules in these colonies gives them a rather rigid consistency, in comparison with the more fleshy colonies of *D. duplicatum* (vide infra); the grey colonies of *D. conchyliatum* are particularly common in Pond H at Lagoon Cays. The species is also common under stones on reefs and ridges; such colonies are usually pure white. Nevertheless positive identification in the field is not easy.

Didemnum duplicatum Monniot, 1983

When growing on *Rhizophora* roots in the ponds, the species is relatively easy to recognize: it forms large hanging fleshy lobes with a slight pinkish tinge; this coloration is due to the reddish color of the zooids showing through the test. The species is fairly common in the ponds and in April 1991 was one of the dominant species in Pond A, but one year later, on April 12, 1992, its numbers had declined (cf. also *Diplosoma listerianum*).

Didemnum inauratum Monniot, 1983

There are no obvious characteristics by which this species may be recognized in the field. I have collected specimens on two occasions in Pond A.

Didemnum perlucidum Monniot, 1983

Several specimens identified as belonging to this species have been found in Pelican Cays. One was collected from a mangrove root in Pond A on May 10, 1992. Five other specimens attributed to this species have been collected from beneath stones on coral ridges adjacent to Manatee Cay, Co-Cat Cay, and Ridge Cay.

Didemnum psammathodes (Sluiter, 1895)

This is a widely distributed tropical species easily recognized by its muddy-brown coloration, which is due to an accumulation of faecal pellets in the test substance. Although it occurs elsewhere on the Belize Barrier Reef (i.e., at Twin Cays) and might be expected to occur commonly in the Pelican Cays wherever there are high levels of suspended particulates in the water, I have only recorded it from Ponds B, BB, and GG, which are mildly eutrophic (cf. Macintyre et al., this volume).

Lissoclinum abdominale Monniot, 1983

This species grows as flat gelatinous, grey sheets and in the field can easily be confused with *Diplosoma listerianum.* Monniot (loc. cit.) described it as viscous (glaireuse) in consistency. In the Pelican Cays I have recorded it from Ponds A, C, G, and J. In Pond A it was frequently found under the lip of the peat bank on the western margin. This habitat is similar to that in which it occurs at Twin Cays further north on the barrier reef. In the type locality in Guadeloupe, F. Monniot (1983a) reports it as growing on the tunic of other ascidians, on coral, and on algae. In Jamaica I have only seen it growing on oyster shells and artificial substrates in an oyster farm. Colonies frequently have a greenish tinge owing to the presence of endosybiont algae.

Lissoclinum fragile (Van Name, 1902)

This is a common species in many of the ponds, usually growing on mangrove roots, on other ascidians, or on the shells of bivalve molluscs. It tends to grow as flat, snowy-white sheets, and as the name implies it is fragile, the test tearing easily to expose the zooids beneath; the

abdomen of each zooid is usually orange, which further assists in identifying the animal in the field.

Lissoclinum verrilli (Van Name, 1902)

This is a common Caribbean species found frequently on the undersurface of stones on reefs and ridges. The colony forms a soft sheet, usually white in color owing to aggregation of spicules around the zooids. The distribution of zooids and spicules gives the colony a characteristic mottled white appearance and makes identification in the field relatively easy. The spicules are different from those of most didemnids having a tetrahedral form (cf. Van Name, 1945). In the Pelican Cays I have recorded it from most of the reef area and from the peat bank in Ponds A, C, E, and H. In the earlier literature the species is often referred to by its synonym *Echinoclinum verrilli.*

Diplosoma glandulosum Monniot, 1983

This is a common species in most Pelican Cays ponds. It is particularly abundant at the northern end of Pond C, where it hangs down from the mangrove roots and peat bank in colorful arrays of gelatinous sheets; in other places it grows freely on the blades of turtle grass (*Thalassia testudinum*) on the pond floor. The coloration in this species varies greatly wherever it occurs in lagoons and ponds on the barrier reef; colonies vary from yellow to green, or mottled black and white. I have only a few records of the species from outside the ponds, on reefs and reef ridges, where it occasionally occurs under stones or on the bases of coral heads or the basal stems of octocorallians.

Diplosoma listerianum (Milne-Edwards, 1841) (Plate 3b)

This is one of the most common colony-forming ascidians in the Caribbean. In mangrove ponds it usually grows as grey gelatinous sheets over mangrove roots and the peat bank and over other sessile organisms in the community, often occupying the interstices between adjacent organisms. The normal coloration is translucent grey with the orange of the stomachs of zooids showing through the test. However, when we first visited Pond A in April 1991, many of the mangrove roots had large drapes of a dark green morph of this species. This coloration is quite different from that in *D. virens* (vide infra) and is due to pigment granules in the test substance. This seems to be similar to the color morph reported by F. Monniot (1983a) from Guadeloupe but is a form that I have only seen at the southern end of Pond C, in GG ponds, and on a single occasion on the base of an octocorallian on one of the ridges.

Diplosoma virens (Hartmeyer, 1909)

This is an Indo-West Pacific species for which there do not seem to be any previous authenticated records from the Caribbean. It is a reef-dwelling species and has never been seen in the ponds. It is a vivid green and forms soft, flat sheets in which the zooids are embedded. The green coloration is due to symbiotic algae (Prochloron). The species is fairly common on the reefs and ridges of the Pelican Cays, often growing on the edge rather than the top of a stone exposed to sunlight. The species is probably common throughout the barrier reef as I have other records from Tobacco Range and from the Sand Bores between Carrie Bow Cay and Wee Wee Cay.

Family: Polycitoridae

Distaplia bermudensis Van Name, 1902

This is a common reef species usually growing as small cushion-like colonies on the undersurface of stones. It also occurs commonly on the peat bank of some of the ponds, especially Pond A and Pond C. In the latter pond it is common in the northwest corner, where it usually occurs as small brown and white colonies easily recognized by the central cloacal aperture surrounded by individual zooids, flecked with white pigment.

Distaplia corolla Monniot, 1974

Originally described from the Azores, this species does seem to have been widely recognized in the Caribbean. F. Monniot (1983c) has reported on its occurrence in Guadeloupe, and I have occasionally seen it on reefs in Jamaica. Colonies are usually circular cushions with a central cloacal aperture on the upper surface, surrounded by a number of individual zooids. There are two distinct color morphs, the commonest being bright orange and less commonly a deep purple form. The species is common in all Pelican Cays ponds, usually in the orange form, and sometimes both morphs live side by side. They are equally common on mangrove roots and on the peat bank, particularly on the lip of the peat bank in Pond H in Lagoon Cays. The species is probably common throughout the barrier reef as it is an abundant component of sessile communities at Twin Cays and on pier pilings at Southwater Cay. Occasionally, *D. corolla* was found on the reef or reef ridges, in which case it was usually the purple morph found under an overhanging lip of rock where wave-wash may create a fairly strong current of water. Such a situation is perhaps a microcosm of what may occur on the undersurface of the peat bank lip in the ponds.

Cystodytes dellechiajei (Della Valle, 1877)

This is one of the most common colonial ascidians in the Pelican Cays and perhaps elsewhere in the Caribbean, although F. Monniot (1983c) does not seem to have found it to be particularly common in Guadeloupe. However, it is often one of the most difficult species to recognize in the field. Typically, colonies form rounded cushions, firm in consistency and varying greatly in color. When growing under stones on the reef, it is often predominantly white, but it also grows in great abundance on the peat bank surrounding most of the ponds as well as directly on *Rhizophora* roots and in these situations is more often brown, black, or a smoky grey, sometimes with a greenish tinge. Many colonies have circular depressions on the upper surface marking a common cloacal area into which the atrial apertures of systems of zooids discharge. The simplest method of identification in the field is to slice off a part of the colony with a dive knife. This reveals the dense accumulation of calcareous discs that surround the abdominal region of each zooid. These discs form a small cup in which the abdomen sits, and they are readily recognizable with the naked eye. However, one must not confuse this situation with the layer of dense spicules (tiny star-shaped calcareous inclusions) found in species such as *Trididemnum hians* (see above).

Eudistoma capsulatum (Van Name, 1902)

Several specimens considered to belong to this species have been collected from the peat bank of some of the ponds (e.g., Ponds A, C, and E).

Eudistoma clarum (Van Name, 1902)

This species forms gelatinous cushions of a glassy appearance. Often the colony is globular in form. It is relatively common along the peat bank and on mangrove roots in Ponds A and H, but I have not found it in any abundance in other Pelican Cays ponds.

Eudistoma obscuratum (Van Name, 1902)

Like other species in the genus, *E. obscuratum* forms rounded cushion colonies but is usually small (1 to 2 cm in diameter) and black. It is fairly common on the peat bank in many of the ponds and occasionally occurs on the reef, often in rock crevices in shallow water, where it is fully exposed to bright illumination. In Pond H, colonies are sometimes large rounded cushions as much as 13 cm in diameter.

Eudistoma olivaceum (Van Name, 1902)

The species has a variable colony form, depending on where it is growing. Small colonies form rounded cushions with a central cloacal aperture surrounded by individual zooids but in quiet lagoons large colonies may develop in which each group of zooids is supported on a long stalk, and clusters of these stalked structures grow closely together on mangrove roots or other supports. Colonies are usually greenish yellow but large stalked clusters may sometimes have a reddish tinge, particularly on the supporting stalk. Although *E. olivaceum* is abundant elsewhere on the barrier reef, especially in parts of Twin Cays, it is relatively rare in the Pelican Cays. I have recorded it in small numbers from most of the ponds (see Table 1), and in such instances the colonies have been small and isolated.

Clavelina oblonga Herdman, 1880

This is probably the best known of all *Clavelina* species in the Western North Atlantic region (see Van Name 1945; F. Monniot, 1983c). It forms clusters of glassy translucent zooids united by vascular structures at their posterior ends and by fragile union of the test substance of adjacent zooids. White pigment flecks may occur in individual zooids. Elsewhere in the Caribbean it sometimes forms massive colonies on mangrove roots (Goodbody, 1993), but I have never seen it occupy such a habitat in the Pelican Cays; instead it sometimes forms small colonies under stones on the reef and reef ridges. Van Name (loc. cit.) records it from similar situations, and at Point Gourda in Trinidad I have recorded it growing on reef structures in about 2 m of water.

Clavelina picta (Verrill, 1900) (Plate 3c)

Morphologically, the species differs little from *C. oblonga* (see Van Name, loc. cit.) but is readily distinguished by its pinkish color. It is common throughout the ponds of Pelican Cays, growing on mangrove roots and sometimes directly on the peat bank or often on the edge of the peat lip, where it is well supported clear of any sediments. It frequently grows in close association with *C. puertosecensis* (vide infra) in such a manner as to make it difficult to distinguish one colony from the other except by coloration.

Clavelina puertosecensis Millar & Goodbody, 1974 (Plate 3d)

The species was first described from very small colonies collected on the fore reef at Discovery Bay, Jamaica, in about 60 m of water; it has subsequently been recorded from a reef in

Guadeloupe by F. Monniot, (1983c). In the Pelican Cays large colonies are abundant in many of the ponds and are immediately recognizable by their deep blue color as opposed to the pink coloration of *C. picta.* Like the latter species, *C. puertosecensis* commonly grows on mangrove roots and on the lip of the peat bank. Both species also often grow on the bases of octocorallians on the reef ridges, especially the ridge extending south from Co-Cat Cay. In Bermuda and on the South Shelf of Jamaica, *C. Picta* is also found growing on octocorallians. Interestingly, although both of these species are abundant in Ponds A and C, they seem to be totally absent from Pond H, where solitary species of ascidian prevail over colonial forms. Neither species occurs at Twin Cays farther north on the barrier reef, but *C. Picta* was found to be common in one lagoon in Blue Ground Range.

Family: Pycnoclavellidae

Pycnoclavella belizeana Goodbody, 1996

This species was first described from specimens collected in the peat bank of one of the mangrove channels at Twin Cays 12 km north of the Pelican Cays. It is a colony-forming species with tiny (1-mm-long) erect zooids arising from vascular structures growing through the surface of the peat at the edge of the mangrove bank. In the Pelican Cays it has been recorded only from the southern shore of Pond G, where it grows in a similar peat habitat. Zooids of colonies seen or collected at Twin Cays are all pure white, while those from Pond G are yellowish. The wide spatial separation of the two localities at which the species has been recorded suggest that it may be widely distributed throughout the barrier reef. The yellow morph seen at Pond G is easily recognizable in the field, but the white morph from Twin Cays is very difficult to detect, particularly as the zooids retract into the substrate if in any way disturbed.

Family: Diazonidae

Rhopalaea abdominalis (Sluiter, 1898)

The normal habitat of this species seems to be in relatively deep water on coral reefs (personal observation; see also Van Name, 1945). It is surprising, therefore, to find that it is relatively common in shallow water in Pond A at Pelican Cays, where it grows on hanging mangrove roots and directly on the peat bank. It is a large maroon ascidian with a thick test containing one or two small zooids. I do not have records of it from any of the other ponds, but several specimens have been collected by scuba divers on the reef ridges at 5 to 10 m.

Suborder: Phlebobranchia

Family: Perophoridae

Two genera of this family are common in the Caribbean, *Perophora* and *Ecteinascidia.* For a review of the genus *Perophora* in the Western Atlantic, see Goodbody (1994). Of the five species reported in that paper, only four have been recorded in the Pelican Cays.

Perophora carpenteria Goodbody, 1994

Perophora carpenteria resembles other species in the genus by having a colony of tiny globular green zooids connected together by creeping stolons. It is not possible to identify this species in the field, but it is the commonest species of *Perophora* on the pond rims, where it creeps along the peat bank and often grows on the blades of seagrass (*Thalassia*).

Perophora multiclathrata (Sluiter, 1904)

The species is difficult to recognize in the field and although its presence in the ponds may have been overlooked, I have only collected specimens from the reef area.

Perophora regina Goodbody & Cole, 1987

This species is easily identified by its large zooids, which form bushy colonies on mangrove roots. Each zooid has a conspicuous white spot bordered by yellow pigment between the two siphons. *P. regina* has been recorded only from Pond B, where it is sometimes found in profusion on mangrove roots. This is the only place outside the type locality at Twin Cays where I have recorded this species in abundance, although some very small colonies have been found in shallow lagoons in Blue Ground Range just south of Twin Cays. Further exploration is likely to reveal a wide distribution in lagoons on the barrier reef.

Perophora viridis Verrill, 1871

P. viridis was found in many of the ponds growing among other members of the sessile community; however, it is not common. Positive identification in the field is difficult.

Ecteinascidia conklini Berrill, 1932

The species was originally described from Bermuda, but its occurrence and distribution throughout the Caribbean have since remained in doubt owing in part to confusion with other species of *Ecteinascidia* (cf. C. Monniot, 1973, 1983a). The species is rare in the Pelican Cays but has occasionally been found under stones on reef ridges or on the basal stems of octocorallians. It is abundant in one of the small lagoons at Blue Ground Range farther north on the barrier reef. The species is readily recognizable by its bright yellow-green coloration and a simple ring of red pigment around each of the siphons. There is an unconfirmed report of a very small colony on a mangrove root on the ridge at the entrance to Pond A in Pelican Cays.

Ecteinascidia minuta (Berrill, 1932)

This is the smallest of all Caribbean species in the genus. Individual zooids are flattened and attached to the substrate by the ventral surface, the entire colony forming a flattened group of pale green zooids attached to one another by vascular stolons. It is fairly common under stones on reef ridges and occasionally grows on mangrove roots or other hard substrata such as oyster shells. I have not seen it growing directly on the peat bank.

Ecteinascidia styeloides (Traustedt, 1882)

The species forms clusters of translucent green zooids intermediate in size between those of *E. turbinata* and *E. conklini.* Many records of *E. conklini* in the literature may indeed refer to this poorly recognized species (cf. C. Monniot, 1983a). *E. styeloides* is abundant in mangrove channels at Twin Cays farther north on the barrier reef but has only been found at a few locations

in the Pelican Cays (cf. Table 1). The records of the species in Ponds B and I and the side arm of Pond H are not surprising as these ponds provide the type of food-rich environment in which this species thrives. Specimens have also been recorded on the ridges.

Ecteinascidia turbinata Herdman, 1881 (Plate 3e)

This is the most easily recognized of all Caribbean species of *Ecteinascidia.* It forms clusters of bright orange zooids connected at their posterior ends by a mass of vascular structures. Although it is widely distributed in mangrove lagoons throughout the region (cf. Van Name, 1945; Goodbody, 1984a, 1984b, 1993), it is not common in Pelican Cays; isolated colonies have been found around the perimeter of Pond A, particularly at the northern and eastern shores. The species is quite abundant in a small isolated pond (BB) on the southwestern side of Manatee Cay, and small colonies occur at the south end of Pond C and in Pond GG. Elsewhere on the barrier reef it is probably fairly common and I have recorded it from mangrove roots in channels at San Pedro and farther north on the reef, but not at Twin Cays.

Family: Ascidiidae

All of the species in this family are solitary forms, sometimes quite large, up to 25 cm in length.

Ascidia corelloides (Van Name, 1924)

This is a fairly cryptic species, usually found under stones on reefs and ridges. It is small and grey-green. Although it is common elsewhere on the barrier reef (e.g., Carrie Bow Cay), it is not common on Pelican Cays ridges or reefs and has never been seen in the ponds.

Ascidia curvata (Traustedt, 1882)

The species seems to be a common inhabitant of reef structures in the Caribbean, often growing on the underside of stones. It is only in such habitats that I have found it in Pelican Cays, although at Port Royal in Jamaica it has recently invaded mangrove ponds and grows commonly on *Rhizophora* roots. C. Monniot (1983a) considers this species name a *nomen conservandum* and lists various synonyms; he further describes a new species, *Ascidia tenue,* suggesting that this also is a synonym (nom nouveau pour *Ascidia curvata*). The nomenclature is therefore confusing, and it seems appropriate to retain Traustedt's original name as a *nomen conservandum.*

Ascidia interrupta Heller, 1878

This is one of the commonest species of ascidian in Pelican Cays. It is grey-green and often 25 cm or more in length. It is common in most of the ponds, often attached to bottom rubble or to mangrove roots, but often partly buried in the peat bank, a niche also occupied by the species in Jamaica (Goodbody, 1966, 1993). At Pond A, I found large populations living among the plates of *Agaricia tenuifolia* on the inner face of the ridge that crosses the mouth of the pond (cf. Macintyre et al., this volume).

Ascidia nigra (Savigny, 1816)

This is an abundant species throughout the Pelican Cays ponds. It is large, 25 cm or more, and jet black in color, so is quite unmistakable in the field. Unlike *A. interrupta,* which often

lives close to the sediments or embedded in the peat (vide supra), *A. nigra* seems to prefer living raised well above the substratum and is thus commonly found on mangrove roots and on the lip of the peat bank. It is common among the plates of *Agaricia tenuifolia* at the entrance to Pond A, and in Pond C is common on the shell gravel on the western rim. In this latter case the shells appear to provide sufficient support to keep the ascidians well clear of the detrital sediments. This preference for a site raised off the sediments has also been recorded in Jamaican communities (Goodbody, 1966). Pond H at Lagoon Cays has enormous populations of *Ascidia nigra*, mixed with other solitary species, surrounding the entire rim and covering the lip of the peat bank and its undersurface. Pond H also has relatively few colonial species, except *Distaplia corolla*. The abundance of solitary species such as *A. nigra* and *Microcosmus exasperatus* is not easily explained. (*Ascidia nigra* is a synonym for *Phallusia nigra,* but *A. nigra* is in common usage in the Caribbean. For a discussion of these two genera, see Van Name, 1945; and Kott, 1985.)

Ascidia sydneiensis Stimpson, 1855

This is a large species, probably often 30 cm in length, but it is difficult to obtain intact specimens. It lives on the bottom, often embedded in sediments, and the only visible sign of its presence is the large bright yellow-green branchial siphon protruding from the sediment. It seems to be fairly common throughout the Pelican Cays, usually at the bottom of ponds and sometimes along the margins of reef ridges, which is where divers have collected specimens attached to the underside of stones. For instance, Ian and Eve Macintyre recovered a specimen from a depth of 10 m on the east side of the ridge between Fisherman's Cay and Ridge Cay on July 25, 1995. *A. sydneiensis* is fairly common around the rim of Pond A in bottom sediments, especially on the eastern side.

Suborder: Stolidobranchia

Family: Styelidae

Botrylloides nigrum Herdman, 1886

This is a common Caribbean species often abundant in mangrove root communities. It is usually brick red or orange and forms flattened sheets. Although it has been found in several of the ponds at Pelican Cays, it is not abundant at any of these locations. Herdman's original specimens from Bermuda appear to have been black in color, and although I have seen such color morphs at Bonaire in the Netherlands Antilles (Goodbody, 1984b), I have not seen them elsewhere in the Caribbean. Black forms of the species were recorded from Pond B in Pelican Cays in August 1995. The species is an uncommon inhabitant of the reefs and ridges.

Botrylloides perspicuum Herdman, 1886

This is an Indo-Pacific species whose presence in the Caribbean has not previously been confirmed. Like *B. nigrum,* it has a flattened growth form, usually thicker than the latter species, and with conspicuous areas of vascularized test between paired rows of zooids (cf. Kott, 1985). It is frequently green or pinkish in coloration. The species appears to be common on the Belizean barrier reef as I have recorded it in several ponds in Pelican Cays as well as at Twin Cays and South Water Cay. *Botrylloides perspicuum* was first described from specimens collected by the

Challenger Expedition in 10 fathoms (18 m) of water off the Philippine Islands. Hartmeyer (1909–11) includes this species in a list of species occurring at Bermuda but provides no details on the precise location; Van Name (1945) dismisses this report as being "evidently a mistake."

Botryllus planus (Van Name, 1902)

The species is small and inconspicuous, often maroon in coloration. It inhabits mainly reef structures but has occasionally been found growing on mangrove roots around pond rims.

Botryllus tuberatus Ritter and Forsyth, 1917

This small species is often black and white, pink, or greenish in color. It is fairly common on ridges or on reefs, where it seems to prefer flat surfaces such as dead plates of *Millepora.* It has been recorded from several ponds, where it often occupies space on dead mangrove leaves lying on the bank or pond bottom.

Symplegma brackenhielmi (Michaelsen, 1904)

A colonial species that forms flat sheets with a characteristic mottled appearance of black, green, and cream. It is common in many of the ponds, where it grows either directly on the peat bank or on large solitary ascidians or oysters. Small colonies having only a few dark green zooids, each with a yellow ring of pigment in the vicinity of the siphons, may also belong to this species, or they may be colonies of *Symplegma viride,* but as yet I have not been able to confirm this identification. Such colonies are found frequently under stones on the reef and occasionally in the ponds on the peat bank or on leaf litter.

Symplegma rubra Monniot, 1972

Colonies are encrusting, usually growing directly over mangrove roots or other organisms such as solitary ascidians and oysters. Individual zooids appear slightly bulbous, colored either bright yellow, pink, or red. Although it is common elsewhere in the Caribbean—for example, Guadeloupe (C. Monniot, 1983b) and Jamaica (Goodbody, 1993)—it appears to be rare on the Belizean barrier reef. In Pelican Cays I have recorded it on a single occasion in Pond E in April 1994. It has not been seen in any of the other ponds, nor do I have records of it at Twin Cays or Blue Ground Range farther north on the barrier reef.

Tibitin halimedae Monniot, 1983

The species forms creeping colonies of tiny globular zooids, initially resembling a very small *Perophora.* In the type locality in Guadeloupe, C. Monniot (1983b) found it growing on stems and leaves of *Halimeda.* It is fairly common on reefs and ridges in Pelican Cays but has always been found underneath pieces of coral rubble away from any source of fine sediments. It has never been seen in any of the ponds. In Jamaica it has been seen only on the undersurface of coral rubble (personal observation).

Polyandrocarpa tincta Van Name, 1902

The species is common throughout the Pelican Cays. In ponds it often forms thick leathery colonies, deep maroon in color, growing as a sheet over a mangrove root or covering other organisms. The individual zooids are bulbous. On the reefs and ridges, it was found as smaller colonies under coral rubble, usually with bright red zooids, often widely spaced.

Polycarpa aurita (Sluiter, 1890)

This species is common throughout the ponds of Pelican Cays. It is easily distinguished in the field from *Polycarpa spongiabilis* by its erect cylindrical form and by its siphons, which have a maroon rim and creamy interior. The atrial siphon is far back on the dorsal side. Like *P. spongiabilis,* it is frequently found on the peat bank and roots and among *Thalassia* on the pond bottom. The species does not seem to have been widely recognized in the Caribbean. I have no records of its occurrence in Jamaican waters, nor have I recorded it farther north on the Belize barrier reef at Twin Cays or surrounding areas. Van Name (1945), using the synonym *Polycarpa circumarata* (Sluiter, 1904), reports on its occurrence in the Gulf of Mexico, Panama, Curaçao, and La Tortuga Island north of Venezuela. The species also seems to be widely distributed in Australia and other parts of the Indo-Pacific region (Kott, 1990). The species has been recorded under a number of different names; for a synonymy see Van Name (loc. cit.).

Polycarpa cartilaginea Sluiter, 1898

This is a small species, seldom exceeding 1.5 to 2.0 cm in length, usually a dull grey-green. It is frequently found on the underside of stones and coral rubble on reefs and ridges, but I have never found it in the *Rhizophora* root communities in the ponds. In August 1991, three specimens were collected from the ridge guarding the entrance to Pond A; one of these was attached to the test surface of a specimen of *Polycarpa spongiabilis.*

Polycarpa spongiabilis Traustedt, 1883

This is one of the most common solitary ascidians in the ponds; zooids are usually squat and bulbous, a dirty grey-green in color. When the large branchial siphon is wide open, it is possible to see the snowy white ring of tentacles just inside the aperture. The zooids are usually fairly soft in consistency. The species is common in all of the ponds, often found on bottom sediments among *Thalassia,* but it also grows on the peat bank and on *Rhizophora* roots. A different morph found in some places, especially Pond G, is pale yellow-grey with faint red lines running vertically down the test. These zooids are firm in consistency with a more cartilaginous test than the other morph.

Polycarpa tumida Heller, 1878

A single zooid considered to be the solitary form of this species was collected from the ridge at the entrance to Pond A in July 1991.

Styela canopus Savigny, 1816

This small styelid is common throughout the Caribbean, particularly in mangrove root communities. The species is frequently reported on by its synonym *Styela partita*; zooids are solitary, but as a result of larval aggregation at settlement, the adults are often found in dense clusters. In the field they can be recognized by prominent dark and light vertical stripes in the interior rim of the siphons. The test is thin and body color is an indistinct grey-green. Although difficult to see among dense clusters of other sessile organisms, the species is fairly common in the ponds but seldom seen on the reef or reef ridges.

Family: Pyuridae

Herdmania momus (Savigny, 1816)

A large solitary ascidian with a pink tinge to the test, the branchial siphon usually with a prominent iridescent green and pink lining. The body is often inflated and globular. The species is very common in Pelican Cays, especially in the ponds, where it is common on soft sediments and among *Thalassia* and less common on the peat bank and mangrove roots. The species is pantropical and common throughout the Caribbean.

Pyura lignosa Michaelsen, 1908

This is a very large solitary species commonly found around the rim of most ponds in the Pelican Cays. Zooids are often deep red but not always attached to the base of a vertically growing mangrove root emerging from the peat. They may also be found among other organisms in the sessile community and growing directly on the peat bank. Large zooids may exceed 15 cm in length. The test is hard and inflexible, and close inspection will usually reveal the presence of scale-like polygonal markings on the exterior surface.

Pyura munita (Van Name, 1902)

A small species, usually only 1.0 to 5.0 cm in length, it occurs in bottom sediments in some of the ponds and occasionally under coral rubble on reef and ridges. Ian and Eve Macintyre collected about 60 specimens at depths of about 10 m just inside the entrance to Pond C on July 28, 1995. At some locations, as in the southwest corner of Pond E, it lives buried in the peat bank, and the only signs of its presence are the elongate siphons protruding from the peat surface; however, small individuals of *Molgula occidentalis* (vide infra) occupy a similar habitat in Pond E. It is difficult to distinguish the two in the field, although the siphons of *P. munita* have an iridescent bluish green lining that may be visible in good light.

Pyura vittata (Stimpson, 1852)

A solitary ascidian reaching a length of 9.0 to 10 cm. The test is firm and thick and usually a drab red-brown. There are no other characters by which the species is easily recognized in the field. The species is common in most of the ponds, living on *Rhizophora* roots and directly on the peat bank. It was also common among coral rubble on the reefs and ridges.

Microcosmus exasperatus Heller, 1878 (Plate 3f)

This is another rather nondescript solitary species that is difficult to identify in the field and sometimes difficult to distinguish from *Pyura vittata.* It occurs in two color morphs, one bright orange, the other a dull grey-green. It is common throughout Pelican Cays in both ponds and on reefs and ridges. It is particularly abundant in Pond H and is one of the most common solitary species on roots and peat banks in Ponds A, C, and E.

Halocynthia microspinosa (Van Name, 1921)

Van Name (1921) originally described this species under the name *Tethyum microspinosum* on the basis of a single specimen believed to have been collected at Andros Island in the Bahamas. Later (Van Name, 1945), he concluded that, since no other specimens had been recorded from elsewhere in the West Indies, a mistake must have been made and the

specimen from the Bahamas was an abnormal specimen of *Halocynthia pyriformis*. Millar and Goodbody (1974) reported on several specimens collected from reefs in Jamaica at depths of 3 to 60 m; they concluded that *Halocynthia microspinosa* is a valid species. On the basis of these specimens these authors redescribed the species.

Since that time I have recorded many specimens from shallow-water reef habitats on the south coast of Jamaica, usually at depths of 0 to 10 m under pieces of coral rubble. Claude Monniot (1983c) describes specimens from Guadeloupe also found growing among coral but does not mention any records from mangrove habitats. In the Pelican Cays I have found it frequently in reef and ridge communities, usually under coral rubble. It has also been found growing in Ponds A, E, G, and H, where it occurs on *Rhizophora* roots and in crevices on the peat bank.

The species is solitary and easily recognized in the field. Zooids are usually 1 to 5 cm long, with a red or orange-red test. The test surface is covered by tiny branched spines and there is a conspicuous ring of larger spines around the margins of the siphons.

Since the species seems to be predominantly a reef species it especially interesting to find it living in mangrove ponds in the Pelican Cays, as is also the case for the normally reef-dwelling *Rhopalaea abdominalis* (vide supra).

Bathypera goreaui Millar and Goodbody, 1974

Species of the genus *Bathypera* are normally found in very deep water (see Van Name, 1945). *B. goreaui* is an exception: the type specimen was collected on the fore reef at Discovery Bay, Jamaica, in 53 m of water, while other specimens were collected in the same area at depths of 55 to 90 m. A single specimen was collected on the ridge at the entrance to Pond A at Pelican Cays on July 31, 1991. The recorded depth was less than 2 m. Although I have no other records of the species on the Belize Barrier Reef, its occurrence in shallow water at Cat Cay suggests that it may be widely distributed in deeper parts of the reef.

Family: Molgulidae

Molgula occidentalis Traustedt, 1883

A solitary and inconspicuous species growing 1.0 to 3.0 cm in length. Large specimens are sometimes found among other components of the sessile community in mangrove lagoons. Small specimens sometimes occur in coarse bottom sediments, often among seagrass (*Thalassia testudinum*). Small specimens are also frequently found embedded in the peat bank, where the only visible sign of their presence is the two protruding siphons. In this latter respect it resembles *Pyura munita* and the two species are often impossible to separate in the field (vide supra). Both species are common in the peat bank in the southwest corner of Pond E.

DISCUSSION

As the contributions in this volume make clear, the Pelican Cays have a rich diversity of fauna and flora; this is especially true in the case of the ascidian fauna, which are far richer than those found elsewhere on the barrier reef. They are particularly abundant on the inner (south) face of the ridge at the mouth of Pond A, where one finds large populations of solitary ascidians, dominated by *Ascidia interrupta, A. nigra, Microcosmus exasperatus* (Plate 3f), and *Polycarpa*

spongiabilis. The ascidians grow in among the plates of the coral *Agaricia tenuifolia,* often partly overgrown by *Zooanthus* in such a manner that only the siphons of the ascidians can be seen emerging through the zooanthid cover. Apart from the solitary ascidians, this inner face of the ridge supports a diverse assemblage of colonial species living cryptically among the coral plates. However, this cryptic fauna is difficult to study without doing unnecessary damage to the reef structure.

Solitary species of ascidian are also abundant in Pond H in the Lagoon Cays, but in this case they are concentrated along the western rim of the pond on the peat bank and among mangrove roots. The dominant species here are *Ascidia nigra* and *Microcosmus exasperatus* (Plate 3f), but there are also large populations of the colonial ascidian *Distaplia corolla.*

The western rim of Pond A and the northwestern corner of Pond C are also areas of high diversity; in both cases the brightly colored colonies of *Clavelina picta* (Plate 3c) and *C. puertosecensis* (Plate 3d) are prominent features of the communities as well as many other colonial species. On the rim of Pond A, *Cystodytes dellechiajei* is particularly abundant. In Pond C, the western rim is the habitat of abundant *Distaplia corolla,* while the northern end has unusually large numbers of the colonial species *Diplosoma glandulosum.* Interestingly, the rims of many of the ponds are inhabited by species that otherwise are characteristic of reef environments. Among these are *Aplidium bermudae, A. exile, Cystodytes dellechiajei,* and *Eudistoma clarum. Rhopalaea abdominalis,* which normally occurs below 20 m in reef habitats, is relatively common along parts of the western rim of Pond A, and *Halocynthia microspinosa,* an otherwise exclusively reef species, occurs on the rim of several of the ponds but always as isolated zooids occurring only here and here. It is not clear why so many reef-dwelling species have invaded the mangrove environment in the Pelican Cays. Note, however, that in every case reef environments—such as the ridge extending across the entrance to Pond A—are in close proximity to the entrances of the ponds (for further details, see Macintyre et al., this volume).

Another interesting feature is the complete absence of *Clavelina picta* (Plate 3c) and *C. puertosecensis* (Plate 3d) from Pond H in the Lagoon Cays, species that are abundant in Ponds A and C. All three of these ponds have an entrance toward the southern end and a closed northern end facing toward the prevailing wind; the mangrove community at these northern limits is sufficiently thin as to permit ingress of water from outside into the lagoon when the wind is blowing strongly. These physiographic features may have no bearing on the absence of the *Clavelina* species from Pond H, which might instead have more subtle associations with the abundance of solitary species in this pond. It should be noted, however, that both species of *Clavelina* are present on reef structures (e.g., the base of coral heads or the base of octocorallian stems) not very far from the entrance to Pond H. Hence population reservoirs of these species do occur in the vicinity.

Nowhere in the Pelican Cays have I recorded colonies of *Perophora bermudensis.* This species is characteristic of localities having a strong water current (Goodbody, 1994), and its absence from Pelican Cays may be due to the absence of such conditions in any of the ponds. The species is common at Twin Cays 12 km further north on the barrier reef.

As Table 1 indicates, most species of ascidian have a wide distribution throughout the various ponds and on the reef ridges; however, the composition varies from pond to pond. In a future paper, I expect to demonstrate that only a few species account for a high percentage of total species abundance. In some cases, a single species (*Ascidia nigra* in the case of Ponds A and H) may contribute as much as 50% of the population and hence most of the biomass.

The high diversity of species along the pond rims, not only of ascidians but of sessile organisms in general (cf. other contributions to this volume) inevitably leads to intense competition between species. This competition can be seen in the frequent overgrowth of ascidians by sponges and also of one ascidian species by another. *Cystodytes dellechiajei* seems to be particularly aggressive in this respect, and it is common to see encounters between two colonies of this species in which one colony is overrolling the other, or *Cystodytes* is growing over another species of colonial ascidian. The expression "overrolling" is apt because the margins of the *Cystodytes* colonies are usually rounded, and at the point of overgrowth one colony appears to be rolling over the other. Similar types of encounter are frequently observed between adjacent colonies of species of *Didemnum.* Species of *Didemnum, Trididemnum,* and *Lissoclinum* frequently grow over zooids of solitary species such as *Polycarpa, Microcosmus,* and *Pyura*; this is not a competitive interaction but is a case of the use of secondary space for growth and development. Several species of sponges compete with ascidians for space and food supply and often grow over ascidians. By contrast, ascidian overgrowths on sponges are relatively rare and usually involve small species such as *Perophora carpenteria,* whose stolonic growth enables it to run over the sponge like a vine.

Despite the diversity and abundance of sessile organisms along the rims of the ponds, a great deal of unused or underutilized space still exists, both at the margin of the peat bank itself and on the many bare patches on root structures. It is difficult to explain this phenomenon, for throughout the year there must be an abundance of larval forms seeking a substrate on which to settle. With mobile sediments along the peat bank constantly falling into the water below (cf. Macintyre et al., this volume), it may be that larvae attempting to settle are inhibited or dislodged by the moving sediment. Any colony-forming species that does gain a foothold may be able to spread along the bank quickly, giving the appearance of a very successful colonist. Many of the peat banks are heavily populated by the alga *Lobophora variegata,* and further research might show that this alga exudes inhibitory substances in its vicinity.

The frequent bare patches on bank roots or hanging roots are no doubt due to quite different factors. They may represent areas in which substantial growths of sessile communities have developed and were later sloughed off under their own weight (cf. Goodbody, 1965), or surrounding communities of sponges may have inhibited settlement of other organisms (cf. Goodbody, 1961). Or they may represent areas grazed by fishes or other organisms. All the ponds have an abundance of juvenile parrot fish, which graze on the roots and peat bank, and their activities, mostly in search of algae, must adversely affect small newly settled ascidians or other sessile forms; over the long term, this could reduce the opportunity for full development of the sessile community. Other predators on the sessile communities include French Angel Fish (*Pomacanthus paru*), which eat sponges but are unlikely to leave a completely bare surface during their grazing; once an angel fish has finished grazing, however, other grazers might "polish" the surface. Few other forces at work are likely to have caused these bare patches. Although mangrove roots grow very rapidly, and many fresh root tips are thus free of colonists, the upper portions of the root also have unused space, which is not so new that there has not been time for sessile organisms to colonize. The phenomenon must be due to either inhibition or destruction.

Other destructive forces may include grazing gastropods or flatworms, both of which might consume newly settled organisms and maintain clean space notwithstanding any attempt at sessile community development. Mature communities may be dislodged either by sloughing

under their own weight (vide supra) or physical disturbance as a result of wave action. Excessive wave action, particularly when created by the wash of a passing boat, causes hanging roots to bang against one another with resultant weakening of the sessile community; sloughing may be enhanced by the activities of crabs (i.e., *Menippe nodifrons*) burrowing among the sessile organisms. Although I have seen this happen in Jamaican mangroves, I have never seen *M. nodifrons* in the Pelican Cays ponds. Trunk fishes (*Lactophrys*) regularly attack large solitary ascidians such as *Ascidia nigra.* They slice open the test and eat out the body from within; attacks such as these usually leave evidence behind in the form of broken test material, but none of the bare spaces that I have examined show evidence of this kind.

The Pelican Cays ponds provide an opportunity to study not only spatial differences in ascidian communities but also temporal changes. I had originally intended to carry out such a study using transect methods, but circumstances have prevented me from returning to the site to complete this work.

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